МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
СУМСЬКИЙ ДЕРЖАВНИЙ УНІВЕРСИТЕТ
ФАКУЛЬТЕТ ІНОЗЕМНОЇ ФІЛОЛОГІЇ
ТА СОЦІАЛЬНИХ КОМУНІКАЦІЙ

СОЦІАЛЬНО-ГУМАНІТАРНІ АСПЕКТИ РОЗВИТКУ СУЧАСНОГО СУСПІЛЬСТВА

МАТЕРІАЛИ ВСЕУКРАЇНСЬКОЇ НАУКОВОЇ КОНФЕРЕНЦІЇ ВИКЛАДАЧІВ, АСПІРАНТІВ, СПІВРОБІТНИКІВ ТА СТУДЕНТІВ

(Суми, 23-24 квітня 2015 року)

INFLUENCE OF HELICAL ELECTRON BEAMS ON DYNAMICS OF WAVES IN PLASMA-BEAM SFEL OF DOPPLERTRON TYPE

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To investigate the device which is capable of generate and amplify a coherent electromagnetic radiation in the millimeter and submillimeter wavelength ranges is extremely important today. In the research under discussion the model of a plasma-beam superheterodyne free electron laser (SFEL)is the following. Plasma is located in the longitudinal focusing magnetic field with strength H_0. Relativistic electron beam is injected into this plasma environment at an angle α with respect to the magnetic field strength vector. We chose a circularly polarized intense low-frequency electromagnetic wave as a pump. This wave propagates along the guiding magnetic field and in the opposite direction to the electron beam. Also we feed a weak high-frequency circularly polarized electromagnetic wave (signal wave) into the system. The direction of the wave signal may be different, so the wave number can either positive or negative. The parametric resonance between the signal wave and the pump wave results in excitation of a space-charge wave (SCW).

As a result of our analysis, we found that the three-wave parametric interactions in the plasma-beam superheterodyne free electron laser are possible in four different cases. It was obtained that amplitude of the signal wave increases in all modes of operation. This is because of difference in the parametric increments of growth. It should be pointed out that previously only one operation mode of plasma-beam SFEL of dopplertron type has been studied [1]. Also, we analyze the dynamics of waves in the researched device for various injection angles α of the beam with respect to the magnetic field. We have established that the gain coefficient of the signal wave grows with increasing of the angle α. This effect is associated with the change of the increment of growth of the plasma-beam instability. This can be explained by the fact that the dispersion function of SCW depends on the longitudinal beam velocity υ_{bz}, and velocity υ_{bz} depends on the angle α $\upsilon_{bz} = \upsilon \cdot \cos\alpha$.

1. V.V. Kulish, A.V. Lysenko, V.V. Koval, *Plasma Physics Reports*. **36**, 1185 (2010).

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